

Spaceborne GPS for Earth Science: Present and Future

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With the completion of the Global Positioning System and the appearance of affordable spaceborne receivers, GPS is moving rapidly into the world of space flight projects. Basic navigation receivers are coming to be seen as almost indispensable to future low earth missions. Perhaps more surprising has been the emergence of direct spaceborne GPS science and the blossoming of new science applications for high precision space receivers. Applications of spaceborne GPS to Earth science include centimeter-level precise orbit determination (POD) to support ocean altimetry; Earth gravity model improvement and other enhancements to GPS global geodesy; high resolution 2D and 3D ionospheric imaging; and atmospheric limb sounding (radio occultation) to recover precise profiles of atmospheric density, pressure, temperature, and water vapor distribution. Figure 1 offers a simplified summary of the Earth science now emerging from spaceborne GPS.

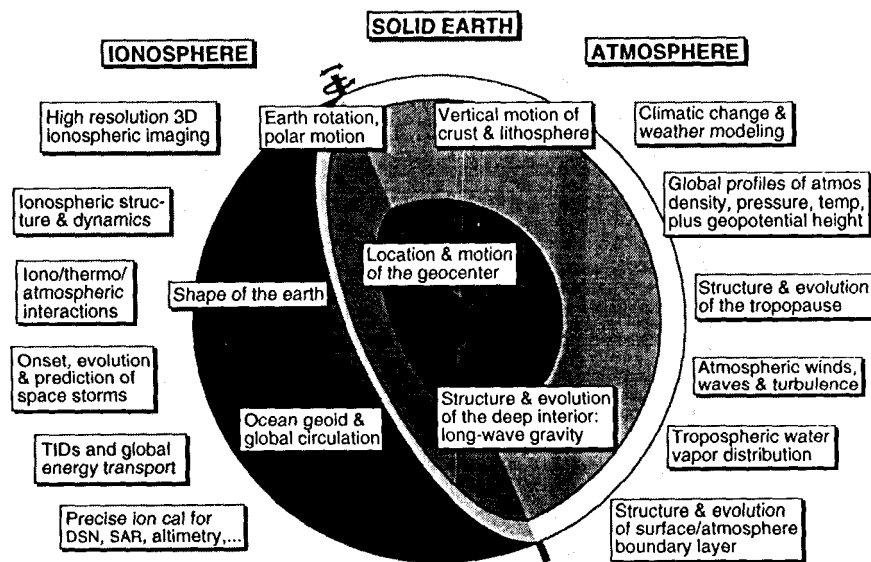


Fig. 1. Some key science applications for a spaceborne array of GPS receivers.

Recently, atmospheric applications have generated considerable excitement. Long-term averaging of GPS occultation data promises to yield atmospheric measurements of unprecedented precision, vertical resolution, and absolute accuracy. A constellation of six orbiting occultation receivers can achieve a refractivity precision equivalent to 0.1 K in temperature within a climate region corresponding to 1/30 the earth's surface, with just a few weeks of data. Vertical resolution can be better than 1 km. This offers perhaps the most promising approach yet to detecting and discriminating among subtle forced climatic signals, which may amount to only a few tenths of a Kelvin average temperature change per decade. To avoid confounding true climate signals with aliased diurnal, seasonal, and other effects, global sampling must be rigorously controlled, implying a constellation with a strictly defined and maintained configuration. This presentation will survey the Earth science applications of spaceborne GPS and describe strategies for achieving a low-cost, autonomous constellation within the next few years.